

CHAPTER XIV: WATERWAYS NAVIGATION RENAISSANCE

As predicted by the Corps, and just as emphatically denied by opponents, the Ohio River Canalization Project completed in 1929 stimulated renewed use of the Ohio River for commercial transportation; and gradually a new traffic developed on the river and some of its tributaries as industries located on the riverbanks to take advantage of low-cost waterways transportation and dependable water supply. In 1935 the costs of moving non-metallic minerals on the Ohio was less than a third and steel products less than a quarter the comparable rail rates.¹

The great bulk of commerce on the Ohio before 1941 was shipments of coal and steel, but during the Second World War shipment of petroleum products began on a large scale. Traffic diversification continued after the war, and by 1956 commodities using the river were too numerous to list. Before 1941 traffic was largely downstream; by 1956 the amount of up and down stream tonnage was about equal. Commercial traffic on the Ohio, which had verged on extinction in 1917, was overwhelming the locks and movable dams of the canalization project by 1956, and construction of a project to modernize navigation facilities on the Ohio commenced.²

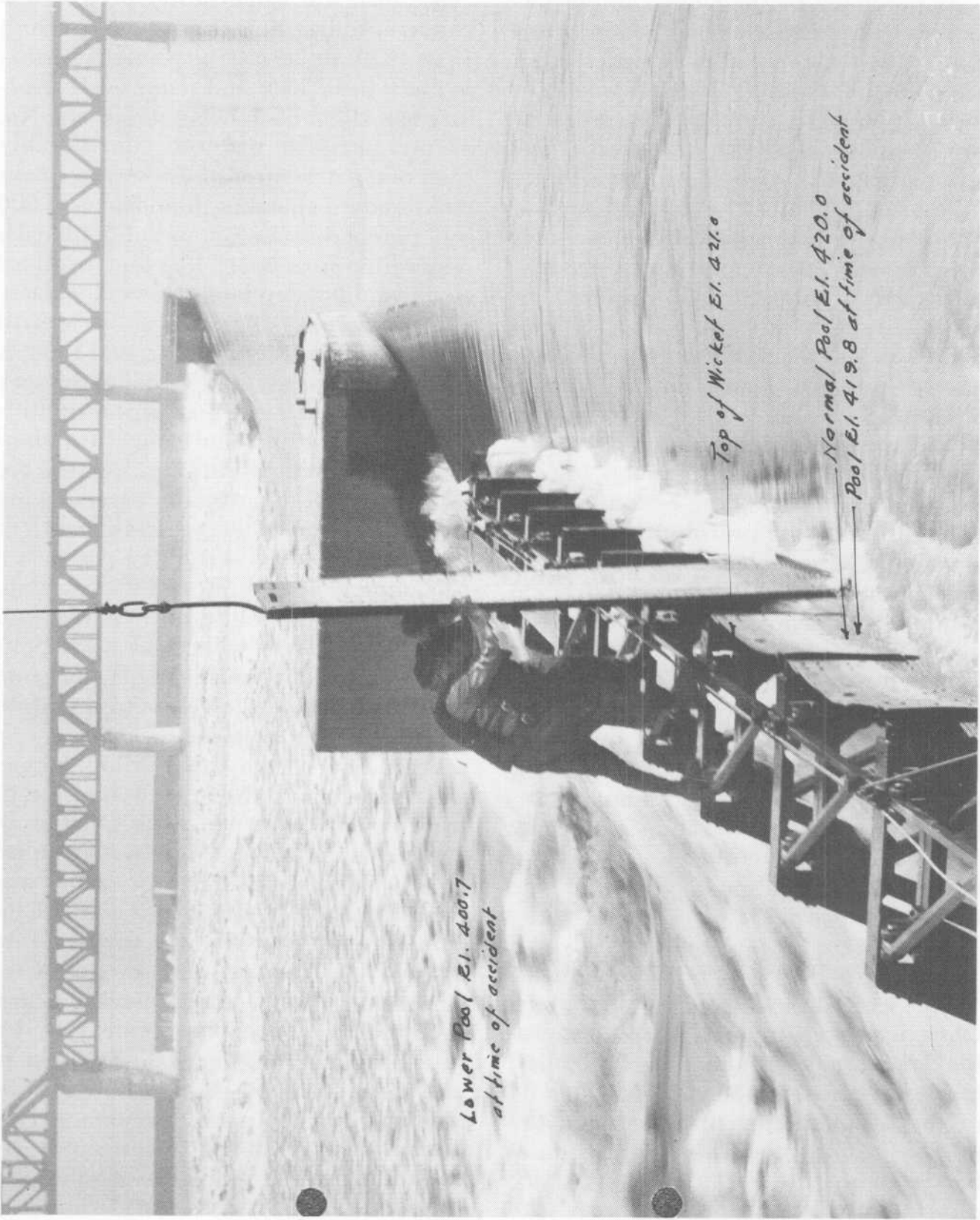
Canalization Project Operation

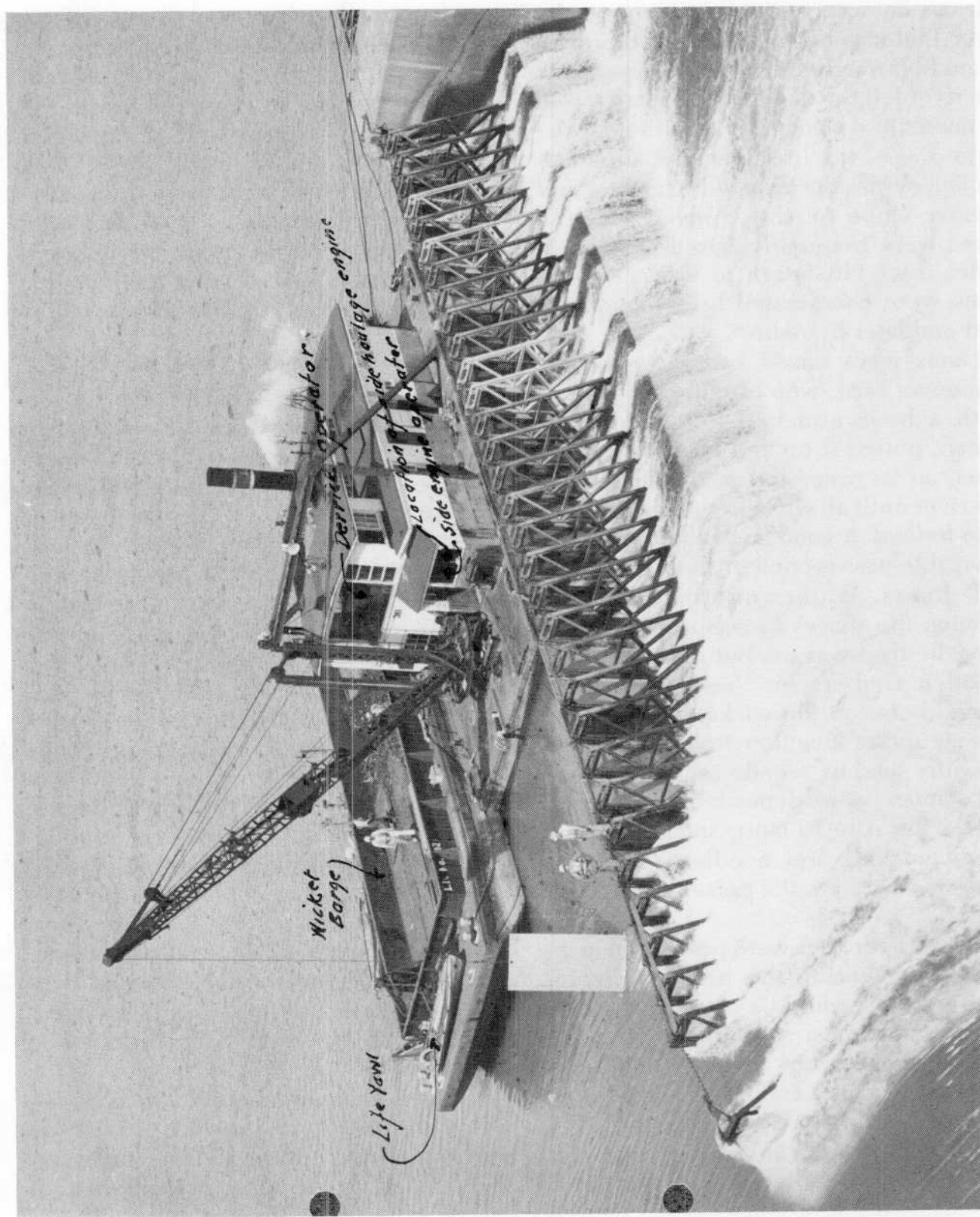
The original canalization project on the Ohio planned fifty-four locks and movable dams, but the elimination of proposed locks and dams numbered 40, 42, and 54 in the Louisville District reduced the number to fifty-one. The construction of fixed dams on the Upper Ohio to replace older structures further reduced the number to forty-six.³

Because the canalization project was constructed over a fifty-year period, 1879-1929, there was not, strictly speaking, a typical lock and dam; each structure had slight design variations, and No. 41 at Louisville differed considerably from other structures of the series. Locks had standard chamber dimensions of 600 by 110 feet, but the amount of lift at each lock varied from 5.6 to 13.4 feet, to afford an eleven-foot depth over lower lock-gate sills. Lock gates were either the Merrill rolling type, or the mitering-gate type. A small turbine on the river wall of the lock and auxiliary power equipment in a nearby operations building furnished power to maneuver the gates. Next to the turbine pit was a navigable pass, varying in width from 600 to 1248 feet, of Chanoine wickets; next to the pass was a Chanoine weir with shorter wickets than the pass; and next to the Chanoine weir were two bear-trap weirs. Bebout wickets were also used in weir sections and some dams had a fixed weir next to the abutment crossriver from the locks.⁴

Operation of the canalization project was analogous to the operation of a railroad division, with the same function of moving traffic through the system in an orderly fashion. Overall supervision was provided by Ohio River Division at Cincinnati, and the river was divided into districts — Pittsburgh, Huntington, Cincinnati (until 1947), and Louisville — and each lock and dam force constituted a subdistrict. In 1924 each lock and dam was operated by eleven men supplemented by temporary personnel. This number was reduced to nine men by 1930, and further reduced as greater efficiency was achieved.⁵

The operation of the project may be il-





Maneuvering Boule Wickets—two views

lustrated by assuming the Ohio at a high-water stage and all dams down, with wickets flat against the foundation on the river bottom and traffic using the open channel through the navigable passes. As the river fell the dam wickets were raised to maintain a slackwater pool before the river stage was less than the nine-foot project depth. Because of lesser flow and greater slope on the Upper Ohio, the dams were frequently raised roughly in order from Pittsburgh to Cairo. Operations were coordinated by telephone at first and later by radio.⁶

Dams were raised by the crew of a maneuver boat, who caught each wicket with a hook attached to a cable and winch, pulled it up and let it settle into place on its prop, and proceeded across the river until all wickets were up and the dam formed. A good crew could raise the navigable-pass section in about three and half hours. Water continued to flow through the spaces between the wickets after the dam was up, but in dry seasons wooden timbers, or "needles," were placed between the wickets to close the spaces and reduce flow from the pool. In very dry seasons, weeds, ashes, and other substances were deposited in the river above the dam to close small gaps between wickets and needles. When the dam was up, all traffic passed through the lock.⁷

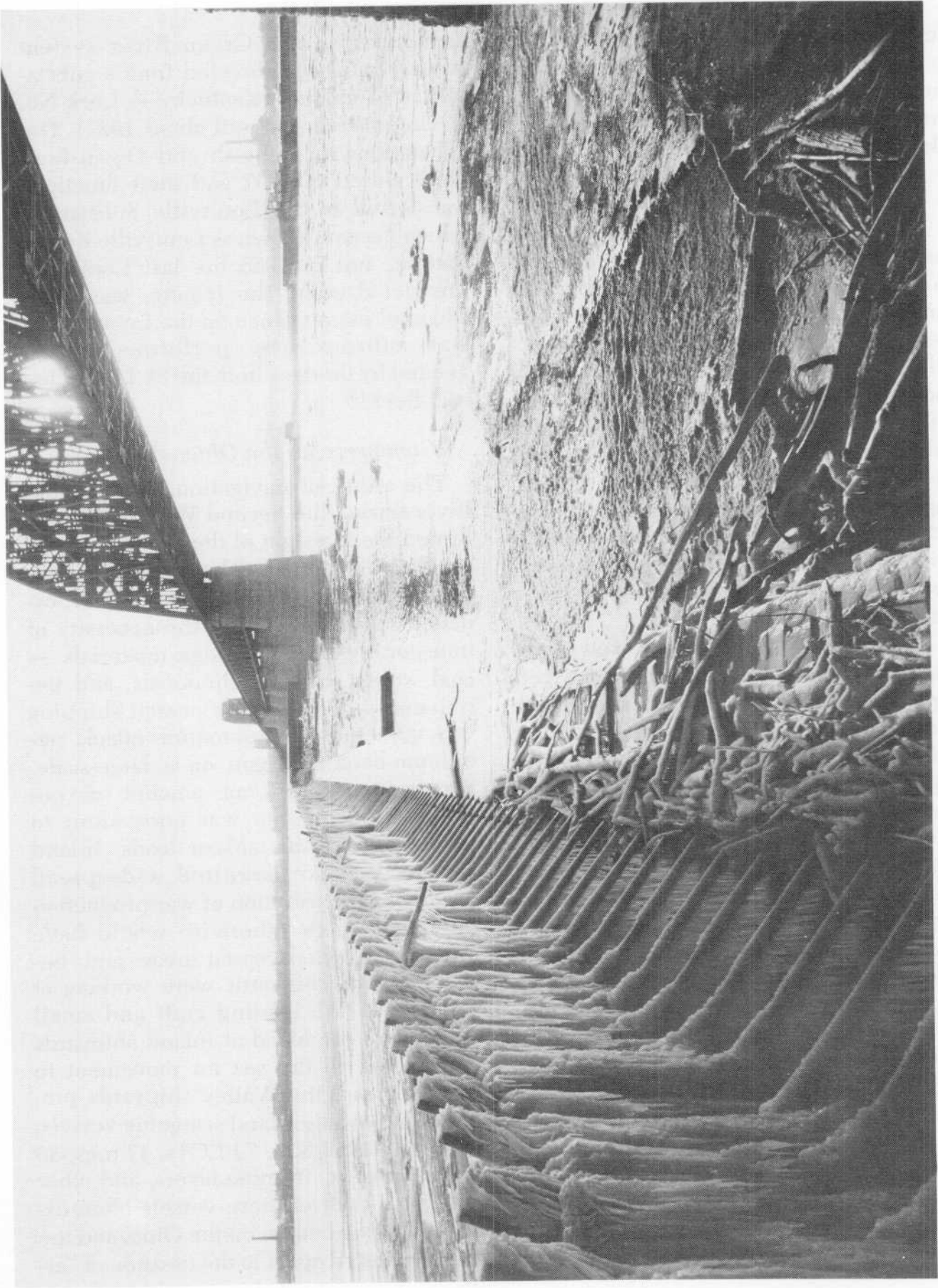
Minor river rises were passed out of the pool by lowering the bear-trap weirs, whose valves could be opened or closed by two men in a skiff. If the rise continued, wicket weirs were lowered to release more water, and finally the wickets of the navigable pass were dropped. The crew of the maneuver boat seized the top of the wickets, pulled them upstream to disengage the props, and let the wickets fall naturally to the bottom. A good crew

in good weather could lower the ordinary navigable pass in an hour and a half.⁸

Maneuvering dams was often a difficult and dangerous operation, frequently performed at night in rain, snow, and ice storms when the river was swift and full of drift. Many maneuver boat crewmen, over the years, fell overboard to their deaths. Ice, which made everything slippery — dams became ice-bound at times — was the greatest hazard. The problems with ice in 1934 were long remembered and will serve as an illustration of the hazards of the work.

On the evening of February 8, 1934, the dams were up and a night-time low temperature of 15 degrees was forecast and the dams were left up. But the temperature dropped to -5 degrees, and on the morning of February 9, the order was issued to lower the dams, for pack-ice was closing the locks. Wickets had to be tripped from the downstream side by pushing on the props till the wickets collapsed; it was done under the threat that pack-ice might descend on the boats at any moment. At one dam, a crew tried to lower the wickets from the upstream side, were caught in an ice gorge, and went over the dam. It took three days to get all dams down. The river then dropped and for the first time since the canalization project was completed in 1929 the project depth was unavailable. The dams were raised in freezing weather, and the project depth was reestablished by February 22. Ice conditions again developed, however, and the dams had to be lowered again in a driving blizzard.⁹

Repair and maintenance work was performed, whenever possible, at a time when it would not interfere with navigation. Lock repairs were usually undertaken in the winter when the navigable pass could ordinarily be left open for traf-



Ice Conditions at Dam No. 41—1958

fic because of high-water stages. Repairs to dams were generally accomplished in the summer when the wickets were in raised position, and were often completed by underwater divers.¹⁰

Channel Maintenance

After 1929, channel maintenance, formerly performed as a separate project by the Cincinnati District, was divided among the four Ohio River Districts. Longer wickets were installed at Louisville District structures and the tops of lock walls were raised during the 1930s, with funds provided by the Public Works Administration, to reduce the amount of necessary channel maintenance. Dredging and other channel rectification projects were completed by the Louisville District Engineer fleet until 1955, however, and thereafter by vessels from other Districts.¹¹

Two types of dredges were used in the Louisville District: the dipper, or bucket, type, which dug like a steam shovel, for the removal of solid and compacted materials, and the hydraulic, or pipeline, type for sandy materials which were more readily removable. In 1931 the District operated the pipeline dredges *C. B. Harris*, *H. S. Tabor*, and *Lake Charles*, and the dipper dredges *Watauga* and *Nolin River*. In 1937 the fleet consisted of the dredges *Harris*, *Taber*, *Nolin River*, *Cincinnati*, *Adams*, *Jewett*, and nineteen derrick boats.¹²

The operation, maintenance, and repair of Ohio River locks and dams in the District and the repair of district floating plant at the canal drydocks was the responsibility of the Louisville Substation. The Paducah Substation directed operation of District dredges and floating plant; and the Owensboro Substation directed the operation and maintenance of navigation

structures on the Green River system (which had been directed from a substation at Woodbury, Kentucky — Lock No. 4, Green River — until about 1927). The substations at Paducah and Owensboro were closed in 1947 and their functions transferred to the Louisville Substation, which became known as Louisville Repair Station, and in 1955 the last Louisville District dredge, the *Jewett*, was sold. Channel maintenance on the Lower Ohio was subsequently performed when needed by dredges from the St. Louis District fleet.¹³

Commerce on the Ohio, 1940-1950

The value of navigation on the Ohio River during the Second World War confirmed the foresight of the builders of the canalization project. The Ohio and connecting waterways relieved the overburdened railway system of the necessity of transporting bulky strategic materials — coal, steel, sulphur, chemicals, and petroleum — and, because coastal shipping was vulnerable to submarine attack, petroleum-barging began on a large-scale. Barges transported an amount of petroleum during the war equivalent to seven million rail tankcar loads. Inland waterways also permitted widespread geographic distribution of war-production industry, which otherwise would have further congested coastal areas; and, because coastal shipyards were working at capacity, 4,031 landing craft and small ships were produced at inland shipyards and floated to the sea for movement to combat areas. Ohio Valley shipyards produced about a thousand sea-going vessels, including 585 LSTs, 74 LCTs, 47 tugs, 36 patrol cruisers, 16 mine-layers, and other craft. The draft of these vessels often exceeded project depth on the Ohio, and the Corps resorted again to the creation of “ar-

tificial waves" by manipulating movable dams to permit movement of the vessels to the coast.¹⁴

No noticeable hiatus in the growth of commerce on the Ohio occurred in the postwar years. The average annual increase in tonnage was about 15% and ton-mileage increase was greater. The Ohio River Canalization Project was authorized in 1910 on a projected traffic forecast of thirteen million tons; by 1950 traffic amounted to 48,598,000 tons and a massive traffic jam was developing. Much of this increase in traffic was generated by new steel, aluminum, chemical, and steam-electric plants which located at riverside to take advantage of low-cost waterways transportation and reliable water supply; and their location in the Ohio Valley had a "rippling" effect, attracting secondary industry to the region to use the primary products and power produced at riverside.¹⁵

Navigation Modernization

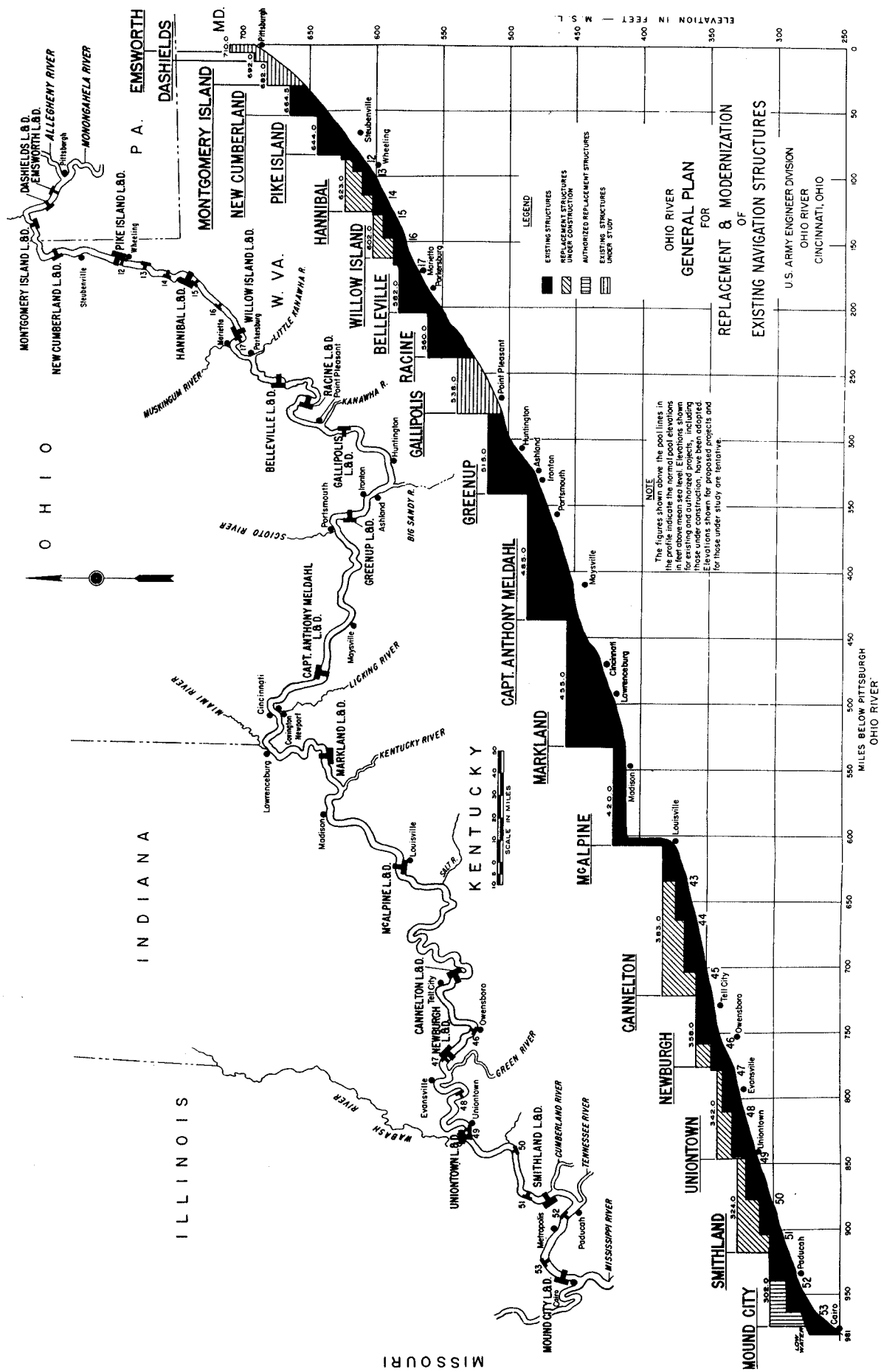
The Corps began planning during the early 1950s to modernize navigation facilities on the Ohio. Nineteen new navigation structures were planned to supercede the old movable dams and 110-by 600-foot locks. Project designs called for non-navigable dams with low fixed sills, and movable tainter gates — metal gates with long trunnion arms to rotate the gates high enough to clear maximum high water. The consensus of river navigators was that a 110- by 1200-foot lock could handle the largest barge tow which could be operated efficiently on the Ohio, and the new locks were designed with these dimensions. An auxiliary 110- by 600-foot lock was also planned to give additional flexibility and capacity at each structure. Whereas the old locks had an average seven-foot lift, the new locks were de-

signed with lifts ranging from 12 to 37 feet.¹⁶

The modernization project had multiple advantages. The maintenance costs of the old system were rising; the new structures would reduce these costs. Greater dam-height and lock-lift would provide longer slackwater pools, reducing the resistance to barge propulsion met in shallow pools and the number of lockages. The larger lock-chamber dimensions would end the double-lockage necessary when tows exceeded the 600-foot length of the old locks; and the new locks were designed with an improved valve and outlet system which permitted filling in about eight minutes, as compared to eighteen minutes at the old locks.¹⁷

Seven of the nineteen new navigation structures — Markland, McAlpine, Cannelton, Newburgh, Uniontown, Smithland, and Mound City Locks and Dams — were tentatively located in the Louisville District. Construction of the project in the Louisville District proceeded in a general downstream order after approval for the modernization program was extended on March 11, 1953.

The District commenced construction of Markland Locks and Dam, about halfway between Louisville and Cincinnati (to eliminate old Locks and Dams Nos. 35, 36, 37, 38, and 39), on April 25, 1956, and completed the locks in 1959 and the dam in 1963. Noteworthy features of the locks were the positioning of the 1200-foot locks riverward of the auxiliary 600-foot locks to facilitate the entry of large tows; the split filling and emptying system permitting rapid operation; and riverside lock discharge outlets, in contrast to the old system of emptying below the lower lock-gates, to minimize turbulence in the lower-lock entrance. The fixed dam had twelve tainter gates, each 42 feet high by



100 feet long between fifteen-foot wide piers. The tainter gates were raised and lowered with electric hoists mounted atop the piers; and the supporting trunnion arms were designed to permit raising the gates above all floods of record.¹⁸

Construction of the new structure at the Falls of the Ohio, named McAlpine Locks and Dam in honor of William H. McAlpine, became a race against time, for old Lock No. 41 had the economic capacity of passing only nineteen million tons annually; tows were waiting for hours at Lock No. 41 in 1955 before they could be locked through. Widening the old Louisville canal from 200 to a 500-foot width began in 1959 and was completed in 1962. The new 1200-foot lock was completed in 1961; and renovation of old Lock No. 41 was completed in 1965. Because the lock completed by General Weitzel in 1872 was left in place, McAlpine Locks and Dam became the only navigation structure on the Ohio with three locks. McAlpine Dam was commenced in 1961 and completed in 1964, with two tainter-gate sections and 4500 feet of fixed concrete weir. One of the most striking features of McAlpine Dam was the old Boulé and Chanoine wicket sections which were left in upright position and imbedded in the upstream face of the dam.¹⁹

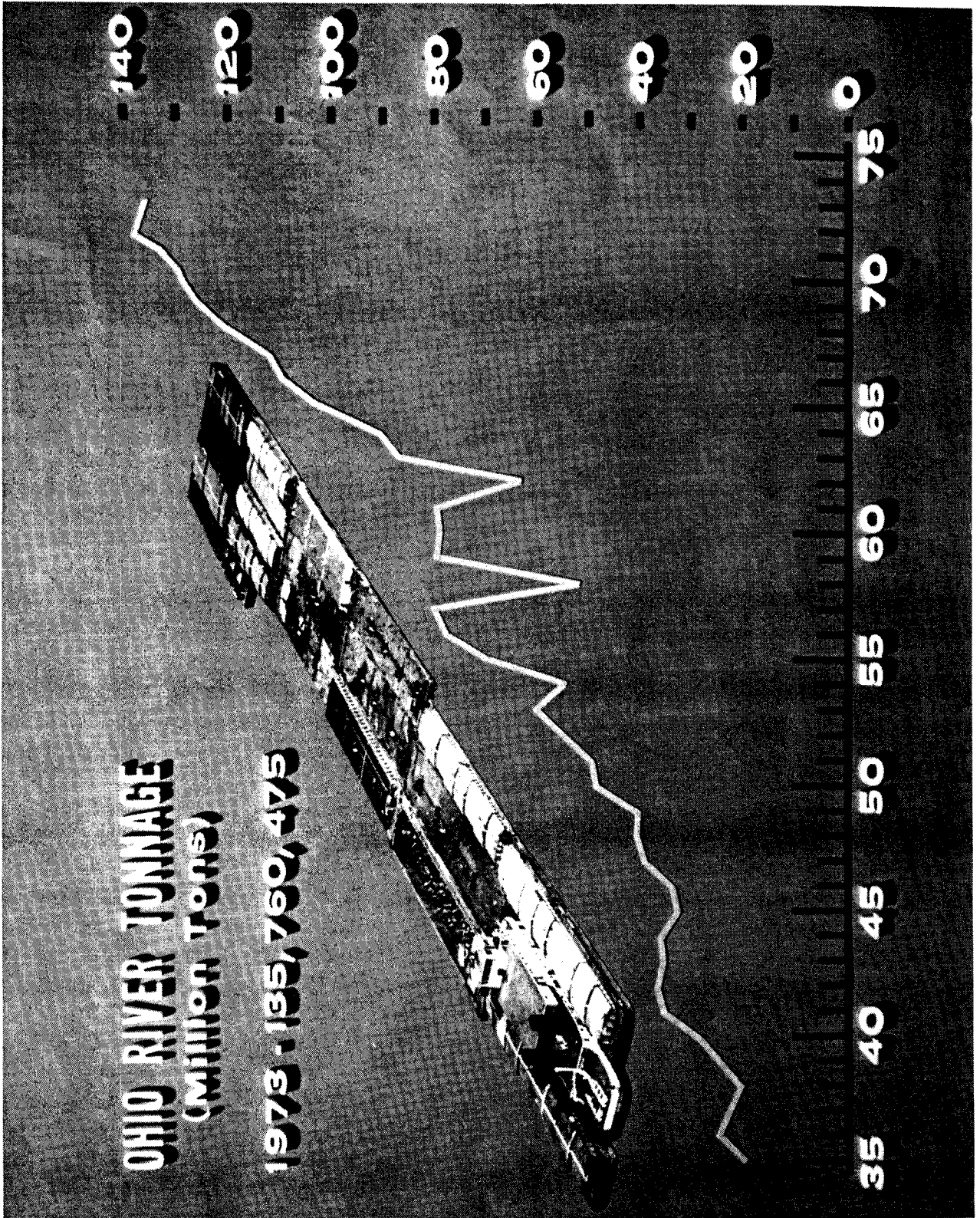
Cannelton, Newburgh, and Uniontown Locks and Dams were at various construction stages in 1975; and completion of all three projects was expected by 1976. Construction of the \$200,000,000 Smithland Locks and Dam project, near the site of Cumberland Dam built by Captain Henry Shreve in the 1830s, began in late 1971, and as a result of an unexpectedly heavy traffic on the Lower Ohio, generated largely by a boom in coal-barging along the Green River and other tributaries, two 1200-foot locks, instead of one 1200- and

one 600-foot lock as at upriver structures, were designed for the Smithland project. Mound City Locks and Dam project was still in the planning stages in 1975, and the greatly increased traffic on the Lower Ohio simply overwhelmed the capacity of old Locks and Dams Nos. 52 and 53. Interim relief for burgeoning traffic was provided at No. 52 (Brookport, Illinois) by construction of a temporary 1200-foot lock on the landward side of the existing lock; and in 1973 planning for a similar stopgap measure at Lock No. 53 (Grand Chain, Illinois) was underway.²⁰

The Runaway Barge Problem

The Engineers in charge of construction of the timber-crib dam across the Falls of the Ohio and the building of Davis Island Dam in the 1870s and 1880s frequently reported that barges, running wild down the river, had injured the structures. The growth of commerce and the completion of the fixed dams of the modernization project led to an apparent increase in this type of accident in the 1960s. In 1967 and in 1972 three serious incidents of this character occurred in the Louisville District.

Fourteen barges broke loose from their mooring above Markland Dam in May, 1967, plummeted down river on a swift current in a fog, and smashed into the dam, wedging in gate openings and wrapping around piers. It was impossible to close seven of the twelve tainter-gates and the pool gradually fell — navigation was suspended on May 25. Floating equipment from Louisville and Pittsburgh Engineer Districts was rushed to the scene and outside aid was acquired to expedite clearing the gates. By a combination of lifting, hauling, flotation, cutting, and dynamiting methods, the barges were removed — the last on May 31. The pool



was rapidly raised and lockage began that afternoon; thirty-one tows were waiting at the time.²¹

Three barge mishaps occurred in the pool above McAlpine Dam during March, 1972. The most serious of the three, the "chlorine barge crisis," began on March 19 when the towboat *J. F. Hunter* grounded on Shippingport Island and lost five barges. Louisville Repair Station personnel secured a sulphuric acid barge which lodged against the inlets of the hydroelectric plant at McAlpine, but another barge carrying 640 tons of liquid chlorine in four steel tanks slammed into Dam Pier No. 2 and lodged halfway through the gate-bay. If a chlorine tank ruptured, it would release a toxic chlorine gas. After a review of alternatives, the decision was made to attempt to stabilize the barge to prevent it going over the dam and to pump the chlorine into another barge.²²

Captain John Beatty was called in as contract salvager with his catamaran rig which had aided in clearing Markland Dam in 1967; and because of the danger to the surrounding community several other federal agencies — Environmental Protection Agency, Office of Emergency Preparedness, and the Coast Guard, which acted as on-the-scene coordinator — were assigned roles in handling the emergency. An empty chlorine barge to receive the transfer moved into place on March 29, and 4400 residents of the Portland area of Louisville near the dam were evacuated as a precautionary measure. On April 1 and 2 the catamaran rig was carefully inched into position over the chlorine barge, sliding cables under the barge hull and winching them up to secure the barge. Once the barge was stabilized, the chlorine was pumped out and removed, and the crisis had passed.²³

Less than a month later, on April 20, a

thirteen-barge tow broke up above McAlpine Dam, and several went over the dam, but public attention centered on another accident at Cannelton Locks and Dam project, where the towboat *Thomas W. Hines*, while preparing to enter the locks with a petroleum tow, lost control and was swept downstream sternmost. The pilot lost his life and a petroleum barge exploded, damaging the Cannelton project and loosing a sheet of flaming petroleum down river.²⁴

Ten barge accidents — collisions, explosions, and sinkings — occurred on the Ohio River from October, 1971, to April, 1972. This type of accident probably cannot be always prevented, but doubtless there are methods of reducing their frequency, and the Army Engineers initiated study of the problem. Congress enacted legislation on July 11, 1972, designed to improve waterways safety by requiring the testing and licensing of towboat pilots and authorizing the Coast Guard to establish traffic-control systems on waterways similar to the system used by aviation.²⁵

Navigation on Tributaries

The United States had acquired several state and private-owned slackwater navigation projects on streams tributary to the Ohio, including the Green and Kentucky River projects, in the late nineteenth century. It will be recalled that the Army Engineers were directed to repair, operate, and extend the projects. Congress also provided funds for the improvement of other streams, such as the Wabash, White, and Tradewater rivers in the Louisville District. Congressional waterways policies of the era were somewhat haphazard, and critics of those policies derided them as the "pork barrel." The reform of "pork barrel" policies began during the early twentieth century — the





The Chlorine Barge lodged on the McAlpine Dam, 1972

Progressive Era — and appropriations for the projects on tributary streams were curtailed. General Harry Taylor, Chief of Engineers, reviewed these developments in 1926:

In connection with the smaller rivers there was formerly a great deal of politics which controlled largely the appropriations and improvements. In 1902 conditions reached such a state that Congress directed that a board, known as the River and Harbor Board, be authorized to pass on all improvements. Since then there has been practically no improvements authorized by Congress that has not been recommended by that Board. About 70% of all the projects reported on by the Board have been reported unfavorably. Since 1920, Congress has adopted the method of making lump sum appropriations instead of itemized appropriations. Formerly, Congress directed where the money should be spent; it is now appropriated as a lump sum available for allotment by the Chief of Engineers, so that if anything is spent on worthless engineering projects, the Chief of Engineers is responsible.²⁶

Few funds, other than those necessary for operation and maintenance of existing projects, were expended on Ohio River tributaries in the Louisville District after 1902. Navigation structures on tributaries were operated as long as commercial traffic used them, but, when the steamboat trade came to an end during the Depression of the 1930s, the Corps began to abandon some projects and allow others to deteriorate because maintenance or replacement costs far exceeded any expected benefits. Commercial navigation on Ohio River tributaries in the Louisville Engineer District was largely intermittent after 1930, but during the 1950s rapid industrial development in the Ohio Valley and the need for coal to furnish power brought renewed interest in commercial navigation on tributary waterways.²⁷

Wabash River Navigation

From 1872 to 1902 Congress appro-

priated \$810,500 for the improvement of navigation on the Wabash — a sum far less than was expended in constructing a single lock and dam on the Ohio River. The Engineers expended these limited funds on removing snags and obstructions, building a few spur dikes and dams closing secondary channels, and constructing a lock and dam at Grand Rapids of the Wabash. By the time Grand Rapids Lock and Dam was completed in 1894, several railroads were serving the transportation needs of the region and the river was in such poor condition above and below the lock that no substantial traffic developed. The Louisville District recommended the construction of a slackwater lock and dam system on the Wabash in 1903 to establish a six-foot navigable depth, chiefly to open coal fields to development, as far upriver as Vincennes, Indiana. But the Board of Engineers for Rivers and Harbors rejected the proposal, commenting that no such project would be advisable until the Ohio River Canalization Project was completed. In 1909 the project for improving navigation on the Wabash was suspended.²⁸

By 1922 commerce using Grand Rapids Lock had dwindled to five tons of mussel shells and twenty-eight tons of unclassified articles; in 1923 traffic shot up to eighty-seven tons. Operation of the disintegrating structure was suspended in 1933 and the property sold to the Boy Scouts of America.²⁹

Support for improving the Wabash for navigation continued, nevertheless, generally in connection with possible use of the Wabash as a section of a proposed waterway linking the Ohio and Wabash valleys with Lakes Michigan and Erie — the possibility which had intrigued George Washington after he had examined Thomas Hutchins' map in 1784. The Wabash River Improvement Association,

for example, urged President Theodore Roosevelt to support such a waterway in 1903, asserting that iron ore and grain from the Great Lakes region would thereby find outlet to the inland rivers and the Gulf of Mexico.³⁰

The National Waterways Commission recommended construction of a barge canal with a fourteen-foot minimum depth from Toledo, Ohio, on Lake Erie across the Upper Wabash Valley to Lake Michigan in 1912; and in 1933 the Louisville District, in the "308 Report" on the Wabash, concluded:

No considerable commerce on the river is to be anticipated unless it is improved as a part of a through waterway to Lake Erie via Fort Wayne and the Maumee River. Such an improvement would require the construction of 31 locks and dams in the river between the mouth and Americus, mile 324, beyond which a canal affords the most suitable form of improvement.³¹

The proposed slackwater project on the Wabash thus became part of a larger project, known as the Cross Wabash Waterway. Proponents of this project asserted that a slackwater project on the Wabash, having at its upper end two canals, one branching to Lake Erie and the other to Lake Michigan, would provide immense benefits. Continued support for such an elaborate waterway system led to congressional authorization of a reconnaissance study in 1967 to determine the feasibility of improving the Wabash for navigation in conjunction with possible canal routes to Lakes Erie and Michigan, with terminals at Toledo, Ohio, Gary, Indiana, and Chicago, Illinois.³²

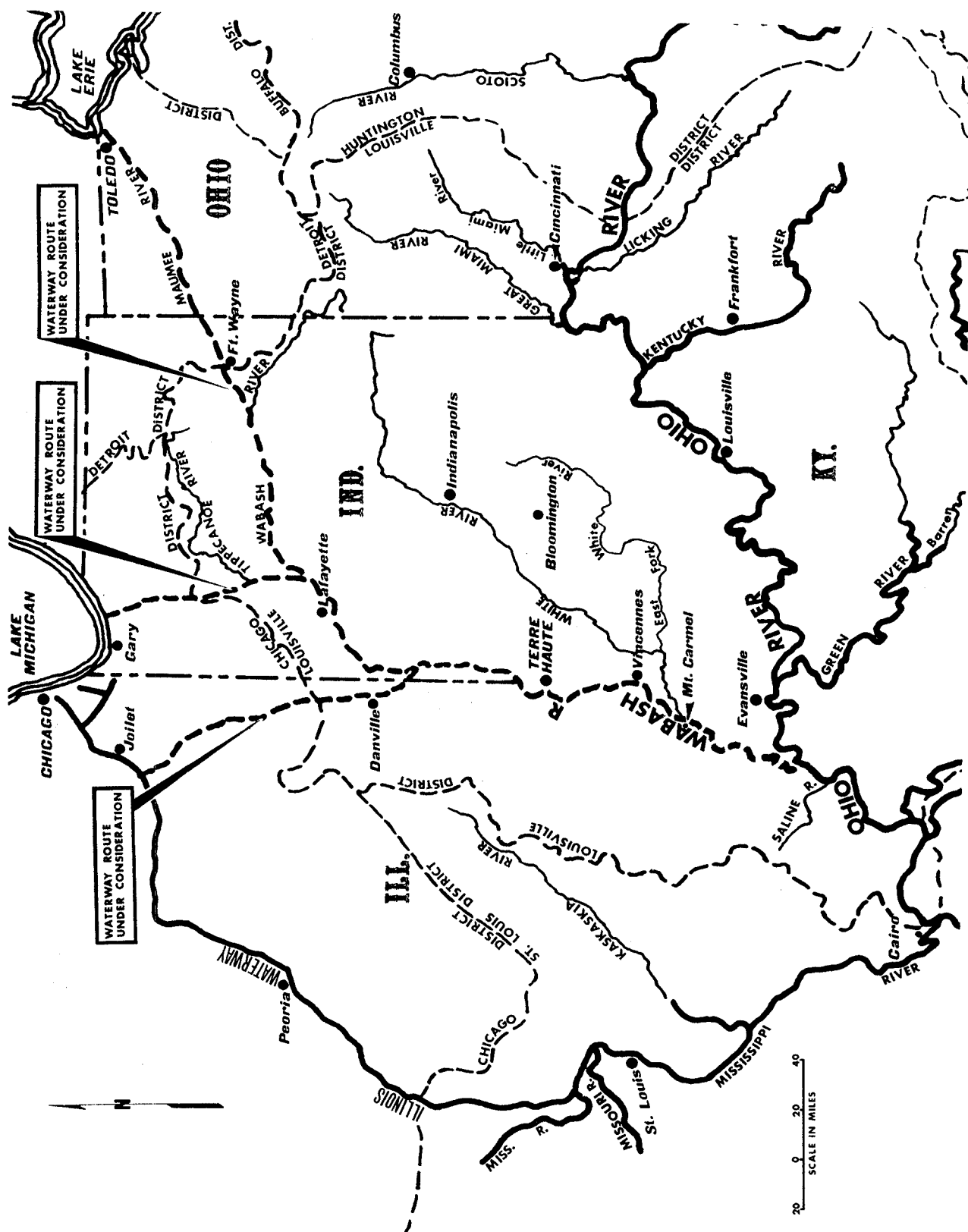
Public hearings on the Cross Wabash Waterway were held in October, 1968, at Terre Haute, Chicago, and Toledo. The states of Illinois and Indiana and many local government entities in the region fully supported the project; and opposi-

tion was expressed by representatives of railroads and of conservationist organizations. The opposition claimed the project would be injurious to an extensive railroad network and would have serious impact on the environment, especially the scenic Maumee River. Opponents claimed the Corps would "contrive" enough benefits to justify construction of the project. Proponents of the waterway declared that it would contribute substantially to the development of the region by providing low-cost transportation for coal, petroleum, and other commodities; they accused the Corps of using the benefit-cost formula only as "a measure to delay development of badly needed improvements."³³

The Louisville District did not recommend a full-scale survey and study of the Cross Wabash Waterway, but it concluded that a study of a navigation project on the Lower Wabash River to serve potential barge traffic carrying coal mined from the immense, high-quality coal reserves of the region would be desirable.³⁴

Green River Navigation

It will be recalled that the Corps of Engineers repaired the state-constructed slackwater system on the Green and Barren rivers after 1888 and extended the system to the Mammoth Cave area by constructing Green River Locks and Dams Nos. 5 and 6, completed in 1899 and 1905 respectively. This was done chiefly to free and facilitate the steamboat packet trade, but a small coal trade also existed. Because of a strike in other coal fields, coal shipment on the Green River rose to 74,765 tons in 1902, but this was an unusually large tonnage. The Louisville District reported in 1913 that reconstruction of the lower locks of the Green River project to permit passage of two coal barges



The Proposed Cross-Wabash Waterway Routes

abreast might soon become necessary "in case of further development of the Green River coal fields," but some forty years elapsed before this became necessary.³⁵

Passenger traffic on the Green River system, which amounted to 11,732 in 1927 and even more previously, had dropped to 2500 by 1931. The last steamboat passenger packet on the Green, the *Evansville*, burned on July 24, 1931, and no effort was made to replace it. The only significant traffic left on the Green was a fleet of small towboats which transported rock asphalt; and this traffic was greatly reduced when the rock asphalt quarries curtailed production during the Depression. Tonnage on the Green, which had been relatively stable at near 600,000 tons per year during the 1920s, dropped to 218,506 tons in 1931. In 1939 tonnage was listed at 164,451 tons, and 962 passengers were reported. The historic log-rafting business on the Green also ceased in 1940. Tonnage, chiefly gasoline and petroleum products, had dwindled to 46,757 tons in 1948.³⁶

It will also be recalled that the first monolithic concrete river lock in the United States had been built on the Rough River, tributary of the Green, in 1896. No significant traffic had ever developed on the Rough; and in 1930 the sole commerce through the lock was 10,039 tons of logs and 240 tons aboard small vessels. Log-rafts were last reported on the Rough in 1940, and in 1941 operation of the lock ceased. The project slowly disintegrated; and in 1959 disposal of the property was authorized.³⁷

It appeared by 1950 that commercial navigation on the Green River system was beyond resurrection; in 1951 the District discontinued operation of Locks Nos. 5 and 6. But Green River navigation was saved by an unprecedented steam-electric

power plant construction boom in the Ohio Basin in the early 1950s. Steam-electric plants were going up at Joppa, Illinois (Electric Energy Incorporated); at Madison, Indiana (Ohio Valley Electric Company); at New Albany, Indiana (Public Service of Indiana); and at other locations. The plant at Madison, Indiana, furnishing electric power to the Atomic Energy Commission, contracted for shipment of two million tons of coal from Green River mines; the New Albany plant contracted for half a million tons; and the other plants would be needing coal. Savings in the cost of shipping coal to the steam-electric plants furnishing power for the Atomic Energy Commission would reduce the cost of the power — a direct savings to the United States.³⁸

In 1953 the Secretary of Army approved a project to rebuild Dam No. 2, Green River, and construct larger locks at Nos. 1 and 2. Congress authorized the widening and deepening of the Green River channel 103 miles from its juncture with the Ohio River. Two new locks, completed in 1956, with chamber dimensions of 600 by 84 feet, replaced the 140- by 36-foot locks built in the 1830s; and the channel was dredged to a width of 200 feet and depth of nine feet. Tonnage, chiefly coal, jumped from 90,000 tons in 1956 to 239,300 tons in 1957. There was no increase in commercial traffic on the upper Green River, however, and when Dam No. 4 washed out in 1965 it was not repaired.³⁹

Tradewater River Navigation

The small appropriations for improving the Tradewater River made by Congress, in spite of protests that the stream should have been "macadamized," during the nineteenth century will be recalled. The Engineers had removed snags and ob-

structions from the stream in the 1880s, and some commercial use of the river had been made. The Louisville Engineer District reviewed the Tradewater project in 1912 and found that the few miles of slackwater on the Tradewater furnished by construction of Lock and Dam No. 50, Ohio River, would adequately serve the region until sufficient traffic developed to warrant additional improvements.⁴⁰

Funds were provided in 1930 to establish a nine-foot channel depth on the lower three miles of the Tradewater, up to the Bell Coal and Navigation Company bargeloading terminal near Caseyville, Kentucky; and in 1931 the dredge *Nolin River* removed 5,200 cubic yards of material, four stumps, and two trees to complete the project. But even the limited coal traffic on the Tradewater dwindled during the Depression years, and the last reported commerce on the river amounted to 882 tons in 1940. Because of the booming coal market in the Ohio Valley, coal-barging on the Tradewater resumed in 1956, amounting to 100,983 tons in 1958. The Louisville District again expended a small sum in clearing the lower three miles of the river of obstructions in 1958.⁴¹

Kentucky River Navigation

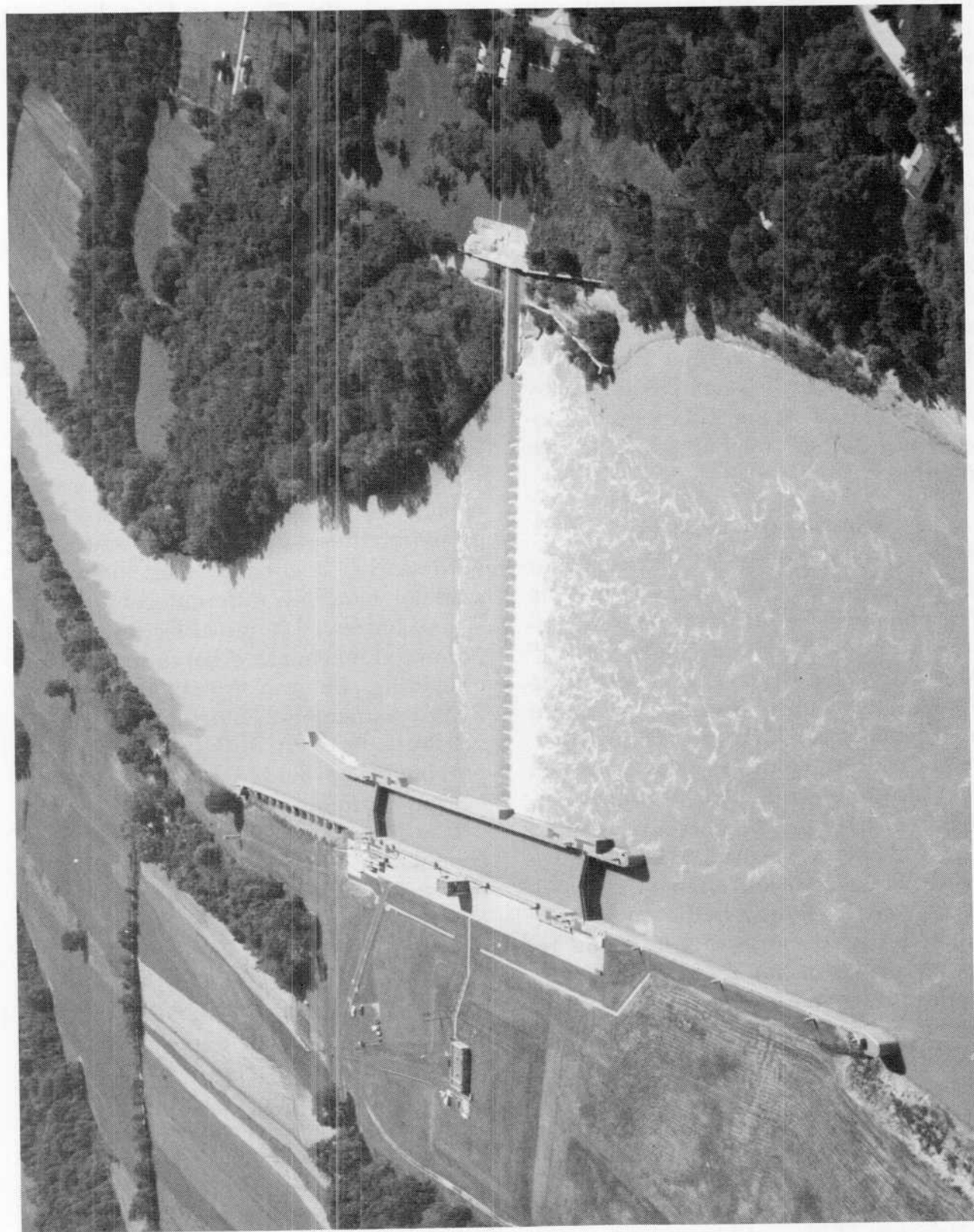
The six-foot Kentucky River slackwater project, comprised of fourteen locks and dams, was completed up to the Three Forks at Beattyville, Kentucky, in 1917. From 1884 to 1917, traffic on the Kentucky, consisting principally of log-rafts, other forest products, and coal barged from the Ohio River up to Frankfort, fluctuated from 150,000 to 400,000 tons per year. The "main object" of the Kentucky River project was to establish dependable navigation up to coal fields of the Upper Kentucky Valley, which, it was expected, would barge coal out via the river once the

project was completed.⁴²

The last lock and dam was completed on January 20, 1917. Because of improved design and increased lock-lift, permitting the elimination of three locks and dams planned in the original project, the Kentucky River project was completed at \$689,910.95 less than the original cost estimate of \$4,865,550. The Beattyville Coal Company opened a mine and coal terminal at Procter, Kentucky, in 1917, and shipped 59,500 bushels of coal down to Frankfort. And the Aetna Refining Company began shipping crude oil from a field near Irvine, Kentucky (Lock No. 12), to refineries at Louisville and Evansville on the Ohio River in October, 1918. The oil was transported at first in wooden barges, but losses due to leakage were heavy and the wooden barges were replaced with steel barges, after the steamer *Advance* and three barges, two of which were transporting 7,500 barrels of crude oil, hit a snag above Lock No. 8 on the Kentucky and exploded.⁴³

Crude oil shipments increased from 3,256 tons in 1918 to 136,482 tons in 1925, but pipelines were subsequently completed and by 1931 oil shipments had ceased. The steamboat trade on the Kentucky ended during the Depression — probably the last steamboat on the Kentucky was the *John H. Soell*, which hauled crossties from Beattyville to Madison in 1938. During the same era, gasoline and kerosene in barrels was barged up the Kentucky River as far as Beattyville from the Pure Oil refinery on the Kanawha River, but traffic as a whole continued to diminish and by 1948 commerce was down to 72,614 tons.⁴⁴

When the Louisville Engineer District took over the Kentucky River project from the Cincinnati Engineer District in 1947, its staff reviewed the project and, after



Lock and Dam No. 1—Green River

finding that commercial traffic no longer used the locks above No. 7 (mouth of Dix River), it recommended that operation of Locks Nos. 8 through 14 be suspended. But citizens of the Upper Kentucky Valley entered strong protests, claiming that prospective commerce was voluminous. The District therefore made further operation of the locks contingent upon development of sufficient traffic to warrant the costs of operation and maintenance. The need of a steam-electric plant near Ford, Kentucky (near Lock No. 10), for coal kept the old locks in operation, for limited coal shipment from Beattyville down to the plant was initiated; and by 1958 commerce on the Kentucky had increased to 317,000 tons and 23.5 million ton-miles.⁴⁵

Riverine Renaissance

The improvement of Ohio River tributaries for navigation in the Louisville District ended about 1900, chiefly because of the reform of "pork barrel" waterways policies and the need to concentrate available funds on major through-waterways like the Ohio River. From the turn of the century to about 1950, the nineteenth-century projects on tributaries were operated and maintained but no attempt was made to modernize navigation facilities and commerce slowly diminished. Passenger traffic ended, the log-raft traffic disappeared, and one by one the steamboats left the rivers. By 1950 it appeared that traffic on tributaries in the Louisville District was beyond resurrection. Structures were rapidly deteriorating, maintenance and operation costs were increasing, and the old structures were simply not designed to serve modern marine equipment.

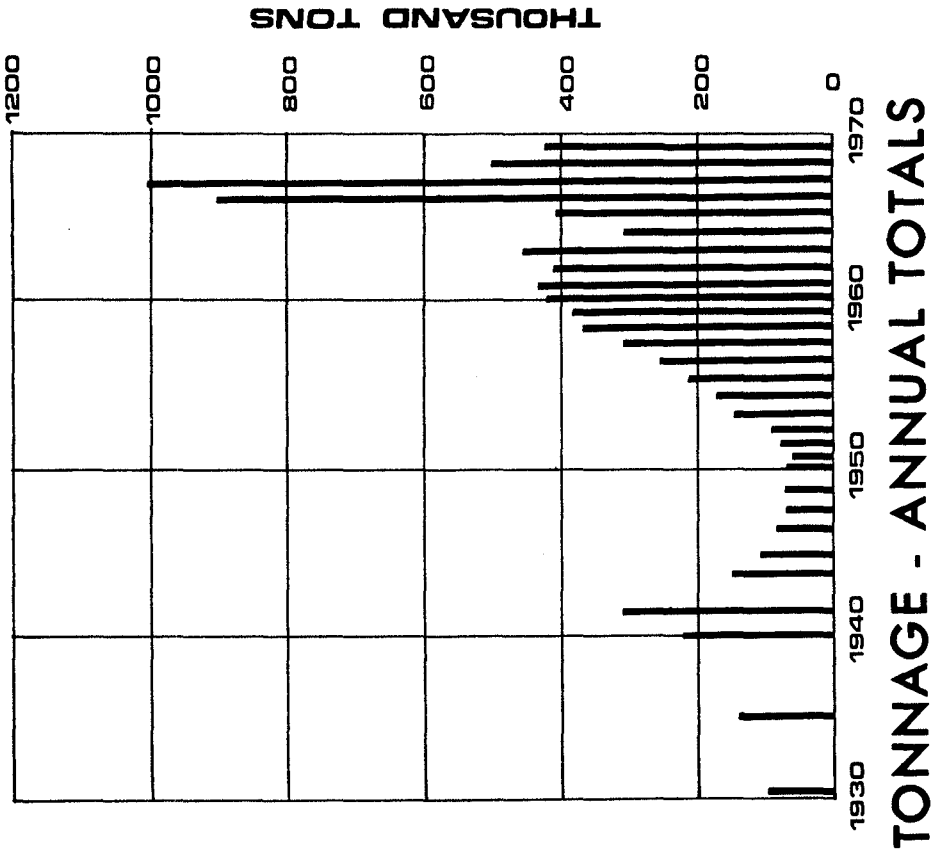
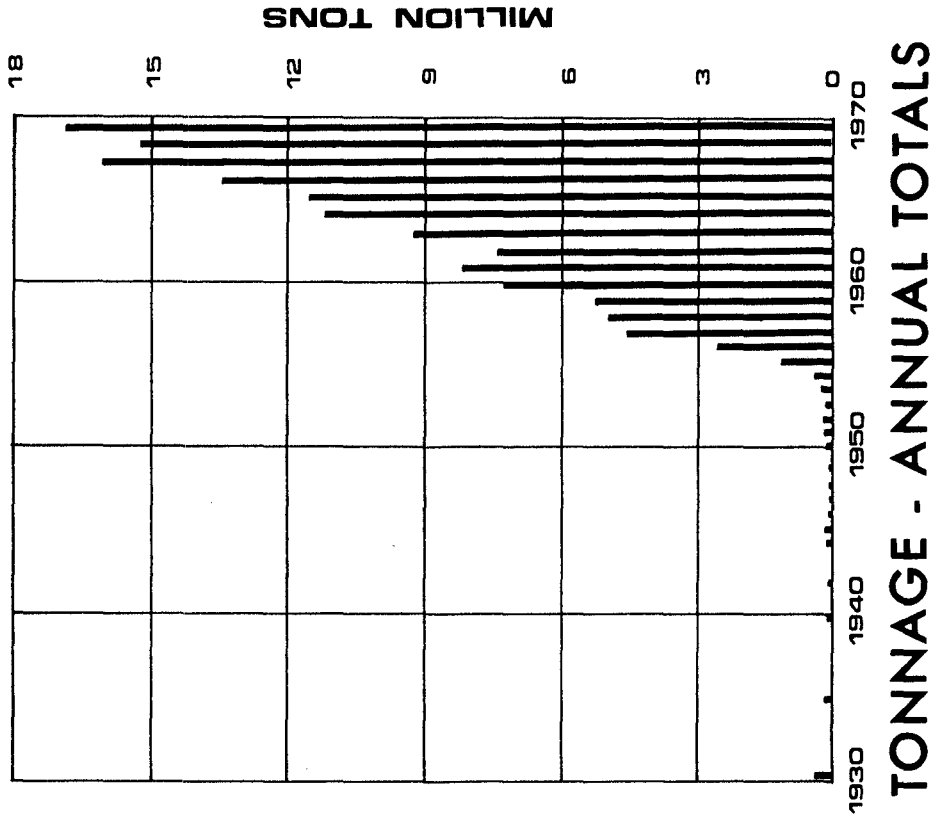
Then, in the early 1950s, in spite of the limitations of the old projects, coal-

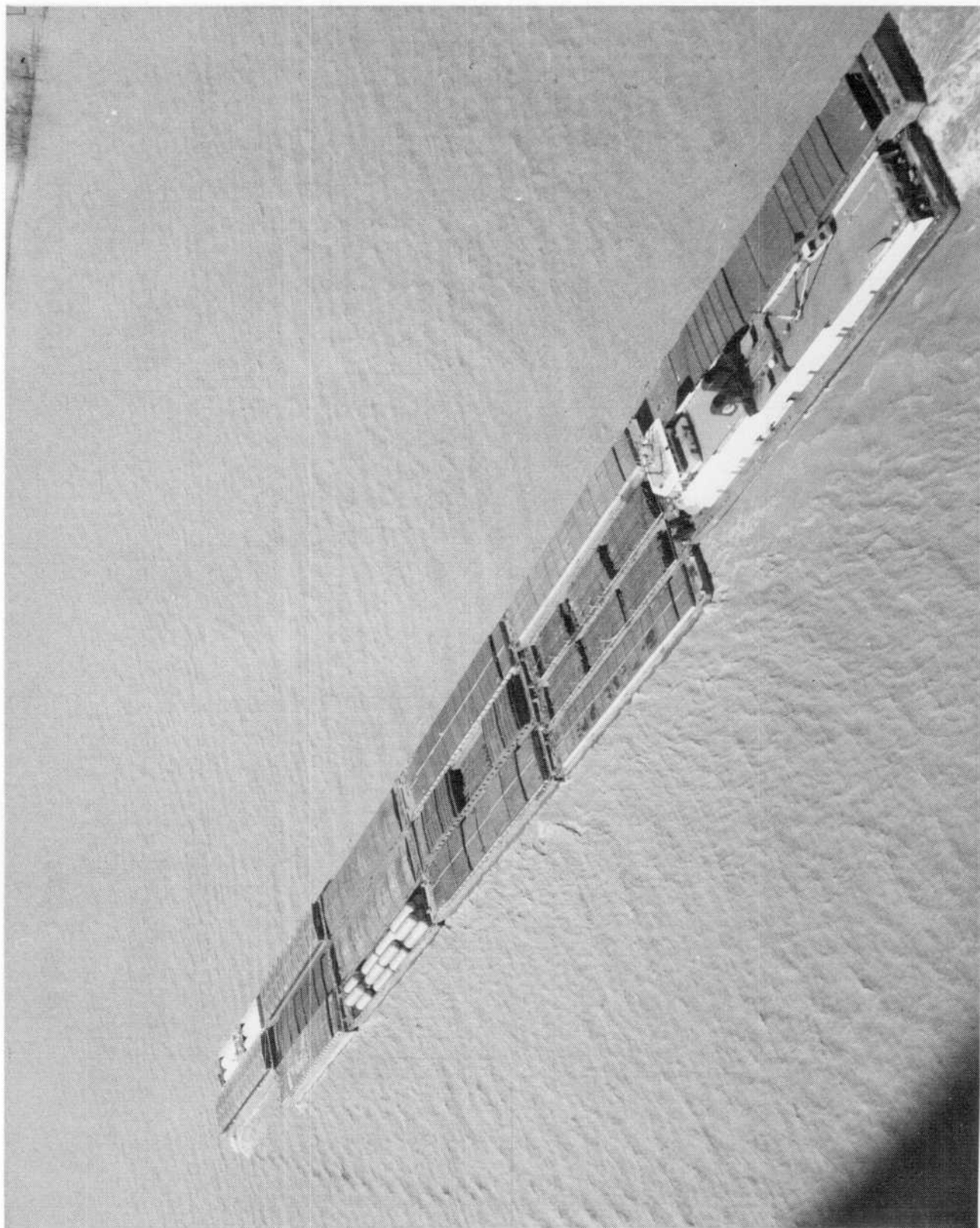
barging began on the tributaries to meet the requirements of new steam-electric power-plants. The need for low-cost shipment of coal provided economic justification for improving the lower 103 miles of the Green River system and continued operation of old structures on the Kentucky River project; the demand for cheap transportation of coal was also primarily responsible for a study of the feasibility of restoring navigation on the Lower Wabash River.

Coal-barging was also an important factor in the renaissance of waterborne commerce on the Ohio River, which resulted in authorization of a navigation modernization project in 1953, but on the Ohio coal was merely one factor among many. Other factors included improved marine design — the development of the twin-propeller diesel-powered towboat, standard welded-steel barges, and specialized craft for handling different commodities — and improved terminal facilities which permitted mechanized barge loading and unloading. But the growth of the Ohio River commerce was much too complex to attribute entirely to the physical improvements provided by hydraulic and marine engineering.⁴⁶

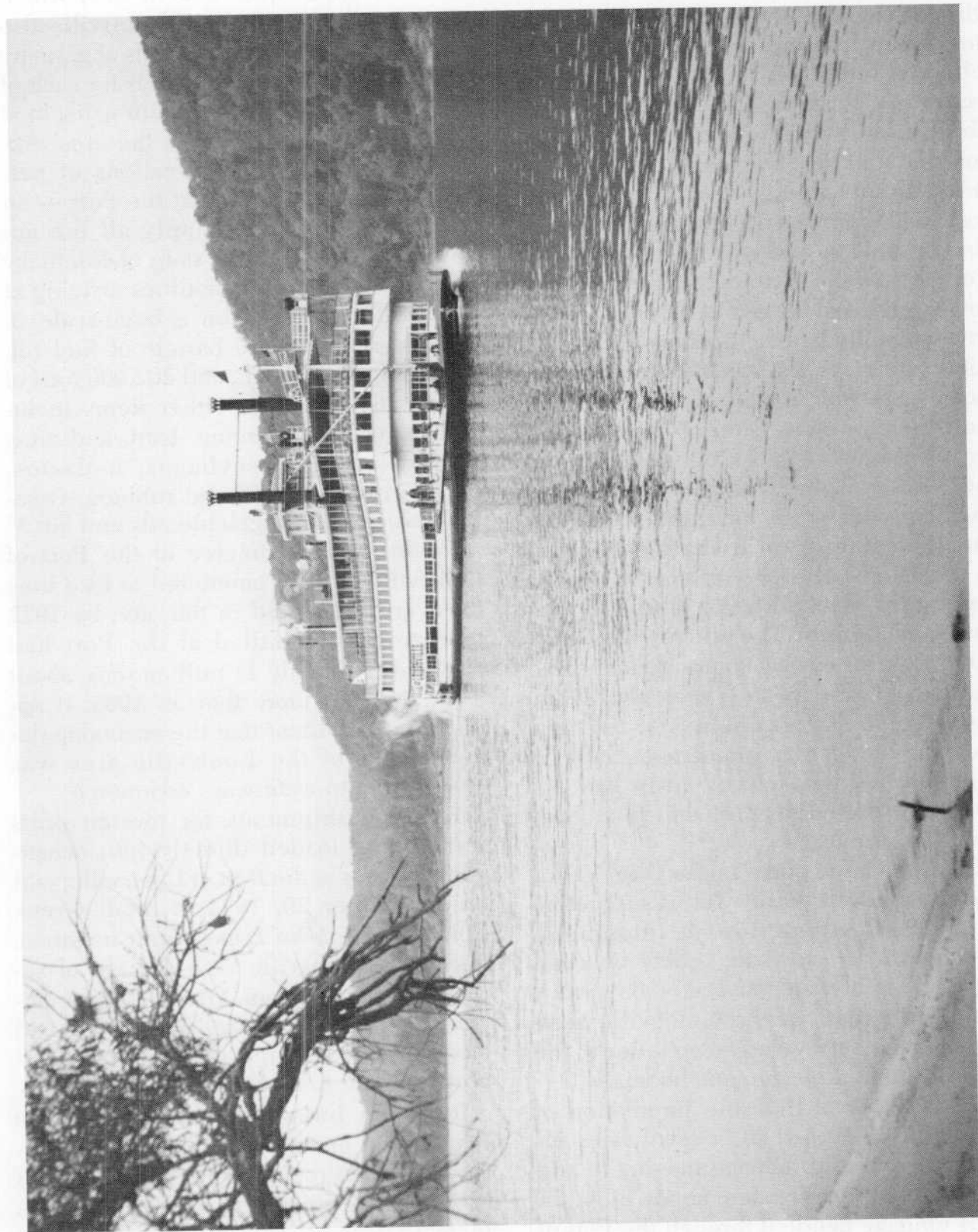
It is difficult to separate the influence of economical waterways transportation on industrial growth from other important elements of the Ohio Valley regional economic structure. Certainly such elements as the abundance of natural resources in the region should be considered; and aspects of the Corps comprehensive water resource development program other than navigation improvement also deserve consideration. But in any analysis, low-cost waterways navigation must figure prominently.

The economic analysis of Ohio Valley industrial development in relation to





A Modern Barge Tow



The Steamer Belle of Louisville

waterways transportation generally follows this line of reasoning. Because of dependable and economic navigation on the Ohio River and some of its tributaries, steel plants, chemical factories, petroleum refineries, and similar primary industries located at riverside in the Ohio Valley. These industries, the increasing population of the Ohio Valley, and the activities of the Atomic Energy Commission in the post-1945 era created a growing market for electric power, and steam-electric plants were built at riverside to furnish this power with coal barged in by river. These developments had a "rippling" effect on both waterways transportation and the regional economic structure, for secondary industries for conversion of basic materials into manufactured products located in the Valley where basic materials and cheap power were available. And the aluminum industry also established plants in the Ohio Valley because of economic waterways transportation and electric-power availability. The primary industries and the steam-electric plants generated an enormous traffic in steel, coal, petroleum, and other basic materials, and the new secondary industries stimulated a traffic in commodities which previously had not been transported on the Ohio to any appreciable extent.⁴⁷

The economic boom in the Ohio Valley after the Second World War was therefore a complex interacting development, which had a "snowball" effect on commercial use of waterways. A 1963 review of the situation in the Louisville metropolitan area provided some index to the magnitude of the economic boom.

From 1950 to 1960 the population of Louisville increased 24%; retail sales increased 54%; and tonnage moving to and from the port increased about 80%. In 1964 tonnage handled through the Port of

Louisville was 7,993,878 tons. It was estimated that \$1,800,000 was the amount saved on the 218,000 tons of steel which arrived at the port in 1963. Louisville also received over a million bushels of grain by barge; that is, about 91 bushels for each of the 11,000 workers in the grain-using food and beverage industries of the area. Approximately 526,000,000 gallons of petroleum products arrived at the Port — an amount sufficient to supply all the automobiles in the entire state of Kentucky for a year. Other commodities arriving at Louisville by barge on a large-scale in 1963 were 1,600,000 barrels of fuel oil, 1,700,000 tons of coal, and 202,000 tons of industrial chemicals. Other items included manganese, chrome, lead, and zinc, plus dried milk, soybeans, molasses, paper products, synthetic rubbers, vegetable fibers, and vegetable oils and fats.⁴⁸

Waterborne commerce at the Port of Louisville in 1963 amounted to 64.3 tons for every household in the city; by 1972 total tonnage handled at the Port had climbed to roughly 11 million tons, about 3 million tons more than in 1963. It appeared self-evident that the economic development of the Louisville area was closely tied to waterways commerce.

By 1965 shipments for foreign ports were being loaded directly into ocean-going vessels at the Port of Louisville; and on November 29, 1971, a small Greek freighter, the *Mini Loma*, built in Japan, docked at Louisville with a cargo of agricultural twine from Mexico. The company operating the vessel claimed it saved money by delivering directly to inland ports without transshipment to barges.⁴⁹

The 200 billion ton-miles of freight transported on inland and coastal waterways in 1970 represented an increase of 50% over the amount handled in 1960; an increase generated chiefly by the fact that

charges for waterborne freight were less in 1970 than in 1960, running counter to a national inflationary trend, and were substantially less than for any other transportation method. It was clear in 1973 that a waterways navigation renaissance was in progress. The days when the colorful gingerbread-trimmed steamboat packets

chugged and thrashed their way along the Ohio and its tributaries, trailing clouds of smoke from their high stacks, except for the exciting annual race between the *Delta Queen* and the *Belle of Louisville*, ended decades before 1973, but the advantages of water transportation have remained.